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ON THE EXISTENCE OF RELATIVE MORAL HAZARD

by

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ABSTRACT

This paper points out that for purposes of estimating the total cost of various health care bills providing comprehensive prepaid care the relevant concept is not "moral hazard" as usually defined, but rather relative moral hazard, the tendency for an individual to increase utilization over what they might have done under a fee-for-service plus coinsurance system.

Although the empirical results are tentative and preliminary, they seem to indicate that great per capita jumps in the consumption of free inpatient care may well have been exaggerated.

Prepared by:

INTRODUCTION

In a recent study in this journal Hyman Joseph [1] compares utilization of inpatient health care facilities with and without third party payments and uses these comparisons to draw some conclusions concerning the existence and character of "moral hazard" resulting from the reduced direct out-of-pocket costs to the consumer.

In particular he focuses on "length of stay" data and finds that in seven (out of 22) illness categories, insurance status "significantly" (in the statistical sense) lengthens the average hospital stay. These seven illnesses can generally be classified as "less serious" medically and thus he draws a policy recommendation that "... the type of insurance plan that would result in less moral hazard would be one that reduces the percentage of the bill the patient pays as the amount of the bill increases. This type of plan would be preferable to actuarily equivalent plans that either require the patient to pay a flat percentage of the bill or require the patient to pay an increasing percentage of the bill as the bill increases." [1, p. 160-1]

These recommendations are fitting if we are addressing ourselves to the problem of how best to preserve the "fee-for-service plus coinsurance" dominated health care delivery system extant. However, it is increasingly apparent that the population at large considers access to adequate health care a right, and that the present delivery system, without drastic modification, is incapable of fulfilling the admittedly large increase in demand for medical services that adoption of such a principle on a national scale would entail.

The extent to which moral hazard may occur is of crucial importance in attempting to construct a modified health care delivery system which hopes to satisfy the increased effective demand resulting from the institution of large scale comprehensive access to care.

The fear is that if we guarantee access to the delivery system through government finance of care (say in the form of the Kennedy Health Securities Act on the national scale, or Senator George Moscone's Consumer Health Protection Act for Californians) utilization will not only increase because more people are covered, but because people previously covered by third party insurance will tend to increase their usage as well, the deductibles and coinsurance features of the health plans having been dropped. This latter phenomenon we will designate Relative Moral Hazard.

It is the purpose of this paper to indicate that the probable degree of such increased utilization of inpatient care ranges from very small to negative depending on the nature of the disease, and that credence must be given to expressed fears that the real problem in the long run is underutilization and not overutilization.

THE STUDY

The working hypothesis for the present study was that in order to best estimate the potential presence of Relative Moral Hazard, one should examine utilization figures for an existing delivery system most closely approximating that which would obtain if large scale comprehensive access to care were implemented. We believe the military health maintenance organization (HMO) to be such a prototype.[1]

Military personnel and their dependents are effectively enrollees in a prepaid comprehensive health care delivery plan with no deductibles and only a nominal copayment for inpatient room charges.[2] They are entitled to financially unlimited access to both in and outpatient medical facilities. The only rationing mechanism is the queue which forms if demand is temporarily greater than the existing supply.

The medical personnel are likewise either military or civilian salaried employees with no economic incentive to overprescribe care.[3]

For these reasons it is felt that careful study of the utilization patterns of military HMO's can lead to a better understanding and more correct projections of the demands on medical resources attendant to implementing the general populations right to adequate health care.

The present paper is a preliminary report of inpatient utilization patterns based on data collected from Silas B. Hays Army Hospital at Fort Ord, California for a two year period (1971 and 1972). A larger comprehensive study covering both in and outpatient utilization patterns is underway and will encompass other military HMO's as well. In the instant paper we limit ourselves to length of stay analyses for 20 of the 22 international morbidity code categories identified by

Joseph. Mean length of stay for each category is calculated from the sample and compared with that realized in the fee-for-service (ffs) plus coinsurance case of Joseph's study.

ANALYSIS

Comparing the mean lengths of stay for 20 disease/conditions for inpatients at Silas B. Hays Army Hospital with those obtained by Hyman Joseph [1] requires a precise statistical formulation. Let μ_i^H be the mean length of hospital stay at Silas B. Hays Army Hospital for disease/condition i, with μ_i^I the corresponding mean length of stay for the Iowa Hospital in [1]. The hypothesis to be tested is that patients with observed "disease" i admitted to Hays Army Hospital actually stayed no longer than those admitted for the same condition at the Iowa Hospitals. That is:

$$H_1 : \mu_i^H \le \mu_i^I \quad \text{for some given } i$$

The following notation is adopted:

$\bar{X}_{Ii}$ ≡ sample mean length of hospital stay for disease i at Iowa Hospital,

N_{Ii} ≡ sample size of patients for disease i at an Iowa Hospital,

S^2_{Ii} ≡ sample variance of hospital stays for disease i at Iowa Hospital,

N_{Hi} ≡ sample size of patients for disease i at Silas B. Hays Army Hospital,

$\bar{X}_{Hi}$ ≡ sample mean length of hospital stay for disease i at Silas B. Hays Army Hospital,

S^2_{Hi} ≡ sample variance from the mean length of stay for disease i at Silas B. Hayes Army Hospital.

The traditional t test, using pooled variance, uses the test statistic

$$t_i = \frac{\bar{X}_{Ii} - \bar{X}_{Hi}}{S_p\sqrt{\frac{1}{N_{Ii}} + \frac{1}{N_{Hi}}}}$$

and rejects H_1 if t_i is "too small," where:

$$S_p^2 \equiv \frac{(N_{Hi}-1)S_{Hi}^2 + (N_{Ii}-1)S_{Ii}^2}{(N_{Hi}+N_{Ii}-2)}$$

represents the pooled variance.

The merits of the t-test may generally be said to rest upon the validity of the assumptions leading to its use. These assumptions are as follows:

1. Both populations (sampled from) have normal distributions.
2. The variances of each population are the same (homoscedacticity).

Under these assumptions, t_i has a t distribution with $N_{Ii} + N_{Hi} - 2$ degrees of freedom. In cases where homoscedasticity cannot be justifiably assumed one may use the statistic

$$t_i' = \frac{\bar{X}_{Ii} - \bar{X}_{Hi}}{\sqrt{S_{Hi}^2/N_{Hi} + S_{Ii}^2/N_{Ii}}}$$

which, if the assumptions of normality are correct, has approximately a t distribution with degrees of freedom

$$df = \frac{[(S_{Hi}^2/N_{Hi}) + (S_{Ii}^2/N_{Ii})]^2}{(S_{Hi}^4/N_{Hi}^3) + (S_{Ii}^4/N_{Ii}^3)} .$$

Interpolation may be necessary if df is not an integer.

The degree to which t_i' yields increased validity over t_i varies inversely with sample size, all things equal. This is so since the t distribution rapidly approaches the standard normal as the degrees of freedom reaches 30. Since our sample sizes are well above 30 for the most part, we should not expect this distinction to be material.

The importance of the normality assumption is also significantly diminished by the central limit theorem which would have t_i being distributed as a standard normal for large sample sizes regardless of the underlying form of the populations. Since our sample sizes range from 30 to 3000 with 4 exceptions, we should not expect deviations from normality to be material. The upshot is that t_i may be used with confidence in the sense that it is not sensitive to departures from underlying assumptions.

Table 1 summarizes the statistical results from the procedure outlined above.

Table 1.

Length of Stay Comparison: Hays vs Iowa Hospitals

DISEASE/ CONDITION	SAMPLE SIZE (N_I)	MEAN LENGTH OF STAY ($\bar{X}_I$)	VARIANCE (S_I^2)	SAMPLE SIZE (N_H)	MEAN LENGTH OF STAY ($\bar{X}_H$)	VARIANCE (S_H^2)	df	t-STATISTIC
Diabetes Mellitus	381	9.7	107.443	162	12.8209	128.4336	541	-3.12
Functional disease of the heart, Fibrillation, Paroxysmal trachycardia	217	9.0	164.716	43	7.930	96.5903	258	.517
Hemorrhoids	240	6.8	9.85688	103	11.699	645.8203	341	-2.94
Influenza with other respiratory manifestations, and influenza unqualified, Grippe	229	5.7	33.4904	39	3.077	16.6518	266	2.715
Bronchopneumonia	338	7.9	1003.67	55	6.309	55.5508	391	.370
Primary atypical Pneumonia	266	9.1	66.8836	7	11.2857	75.238	271	-.695
Acute Bronchitis	603	6.3	37.4020	92	5.2826	40.4907	693	1.483
Hypertrophy of tonsils and adenoids	1357	1.7	1.16699	72	2.305	.37011	1427	-4.688
Ulcer of Duodenum	439	8.7	56.465	38	13.60526	120.678	475	-3.699

DISEASE/ CONDITION	SAMPLE SIZE (N_I)	MEAN LENGTH OF STAY ($\bar{X}_I$)	VARIANCE (S_I^2)	SAMPLE SIZE (N_H)	MEAN LENGTH OF STAY ($\bar{X}_H$)	VARIANCE (S_H^2)	df	t- STATISTIC
Gastritis and Duodenitis, Gastrohepatitis	428	4.4	13.3988	28	7.25	92.4166	454	-3.43
Acute appendicitis	437	6.6	27.4433	19	17.473	82.0965	454	-8.525
Hernia of abdominal cavity without mention of obstruction	792	7.1	36.3002	294	9.0374	117.1317	1084	-3.72
Gastroenteritis and Colitis; except ulcerative, age 4 weeks and over	799	4.7	15.1020	344	2.64825	13.7914	1141	8.307
Cholelithiasis, Colic	448	10.4	51.4254	21	14.00	745.70	467	-1.79
Cholecystritis without mention of calculi	250	9.0	49.9435	18	9.833	116.8529	266	-.464
Disorder of menstruation, Dysmenorrhoea, Metrorrhagia, Mittelschmitz	300	3.7	9.88685	194	3.3917	9.05817	492	1.0877

DISEASE/ CONDITION	SAMPLE SIZE (N_I)	MEAN LENGTH OF STAY ($\bar{X}_I$)	VARIANCE (S_I^2)	SAMPLE SIZE (N_H)	MEAN LENGTH OF STAY ($\bar{X}_H$)	VARIANCE (S_H^2)	df	t-STATISTIC
Abortions without mention of sepsis or toxemia	359	2.7	5.85159	204	2.544	3.9211	561	.784
Delivery without complication, stillborn	3757	4.4	2.53556	1119	3.6264	3.3308	4874	13.778
Displacement of intervertebral disc, rupture, herniation, protrusion, prolapse	305	11.2	59.7469	35	12.8285	94.6168	338	-1.147
Fracture of neck of femur, Hip	221	24.3	2441.09	31	81.5484	5421.2559	250	-5.646

The following diseases/conditions were significant at a .99 level of significance since $t_{.01}$ for all diseases/conditions was -2.326: That is, H_1 is rejected for the following diseases.

Diabetes Mellitus

Hemorrhoids

Hypertrophy of tonsils and adenoids

Ulcer of Duodenum

Gastritis and Duodenitis, Gastrohepatitis

Acute appendicitis

Hernia of abdominal cavity without mention of obstruction

Fracture of neck of femur, hip.

If the confidence limit was relaxed to .95 an additional disease/condition was significant:

Cholelithiasis, Colic

As a first approximation to interpreting the results of this data, we may simply note that for the 9 morbidity conditions noted above, the Hays Hospital and the free comprehensive case system did have significantly longer lengths of stay. However, in 11 of the 20 cases the hypothesis was not rejected.

It should immediately be noted that the data from Hays Hospital was not age or sex adjusted for differences in the population served vis-a-vis the population of the Iowa Hospitals.[4] However, a qualitative consideration of the probable differences in the populations would seem to mitigate the failure of the hypothesis in at least some of the cases cited above. For example, it appears that a more significant proportion of the "enrollees" at military HMO's are in the over 60 age class because of the existence of a large retired military population on the Monterey

Peninsula. This, of course, leads to longer lengths of stay, ceteris paribus, compared to civilian eligible populations.

There also exist institutional differences in hospital policies which tend to result in longer stays in military HMO's and would not be present in the usual civilian counterpart. These include the existence of "medical boards" and the recuperative role of the HMO.

"Medical boards" are formal medical inquiries made after certain types of illnesses in order to determine whether active duty personnel are fit to resume their previous positions. These unfortunately take a not insignificant amount of time (which varies with the type of illness) during which period the patient remains attached to the hospital even though he is medically "cured," in the sense inpatient care is no longer necessary. Thus, in the case of fractures and hernia's for example, we might expect, a priori, longer stays in Hays <u>vs</u> the Iowa group.

By the same token, there exist patients who in "normal" (i.e. civilian) circumstances would be sent home to finish recuperation but can't be sent back to the barracks for lack of even cursory custodial care. They are thus kept on in their inpatient role, leading to longer lengths of stay. This may well explain the failure of the hypothesis in cases such as diabetes mellitus, hemorrhoids, etc., which require such periods of recuperation.

These results, however formal, are qualitative and difficult for a policymaker to interpret unless we include an overall measure of hospital utilization such as "patient-day equivalents." Very simply, we view the data from the Iowa Hospital as a base and then compare the number of patient-days for each disease at Iowa Hospital with the

corresponding number at Silas B. Hays--adjusted to account for the difference in sample sizes. Table 2 summarizes the results.

The bulk of the difference of 21,000 is due to appendicitis and neck fracture, where in both cases the sample sizes at Silas were small. If these two cases are ignored, the difference comprises a mere two-thirds of one per cent increase at Hays. Further comparisons of a more controlled nature would seem to be of considerable interest.

TABLE 2.

Disease/Condition	Patient Days Iowa	Hays (Adjusted)
Diabetes Mellitus	3700	4900
Functional Heart disease	1950	1720
Hemorrhoids	1630	2800
Influenza	1305	705
Bronchopneumonia	2670	2130
Pneumonia	2420	3000
Acute Bronchitis	3800	3190
Hypertrophy of T and A	2300	3120
Ulcer of Duodenum	3810	5980
Gastritis	1880	3100
Acute Appendicitis	2880	7650
Hernia	5630	7160
Gastroenteritis and Colitis	3760	2120
Cholelithiasis, Colic	4670	6280
Cholecystritis	2250	2450
Disorder of menstruation	1110	1010
Abortions	970	915
Delivery	16,540	13,600
Displacement	3420	3920
Fractures	5380	18,000
TOTAL	72,075	93,750

CONCLUSIONS

We began by pointing out that for purposes of estimating the total costs of various size comprehensive health care bills the relevant concept is not "moral hazard" as usually defined, but rather relative moral hazard, the tendency for an individual to increase utilization over what they might have done under a ffs plus coinsurance system, which is most prevalent presently.

Although we by no means have proven that relative moral hazard does not exist, we believe that our initial and admittedly crude examination of a military HMO, adjusted for characteristics which would not be present in a civilian prepaid facility, indicates that projections of great per capita jumps in the consumption of free inpatient care may well have been exaggerated.

REFERENCES

1. Hyman, Joseph, "Hospital Insurance and Moral Hazard," *Journal of Human Resources*, VII, No. 2, p. 152-161.

FOOTNOTES

1. The problems involved in such an assertion are addressed later in the paper.

2. The daily "rations" charge runs from $1.25 for enlisted men to $1.75 for officers.

3. Further, they do not have the same potential economic incentive to <u>under prescribe</u> that doctors who are members of a profit sharing group may have.

4. We are as yet unable to rigorously perform such an operation due to the unavailability of age-sex data directly with the morbidity and diagnosis data, and the as yet incomplete development of a method of defining the exact population served by military HMO's. This stems from accessibility to cure by both active and retired military personnel and dependents in overlapping health care districts. One of the authors (Whipple) is presently directing a study to provide the necessary methodology with reasonable accuracy.

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